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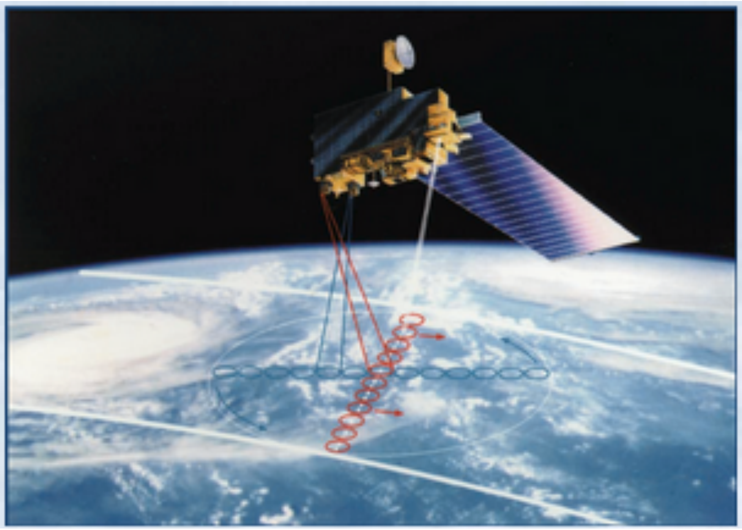
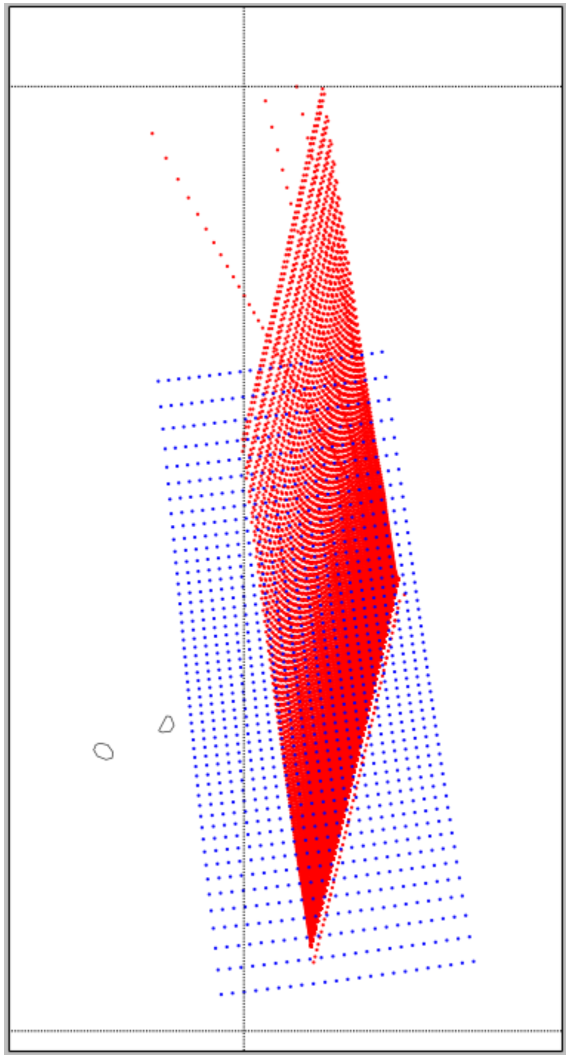
INTER-SENSORS COMPARISON SCARAB/CERES

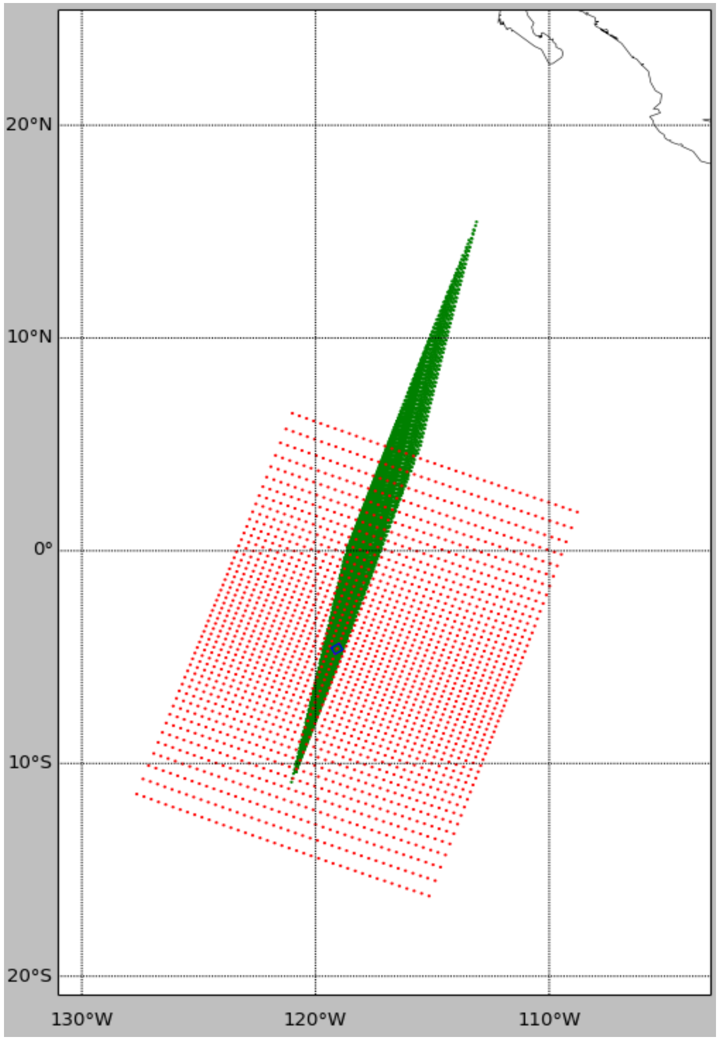
Sommaire

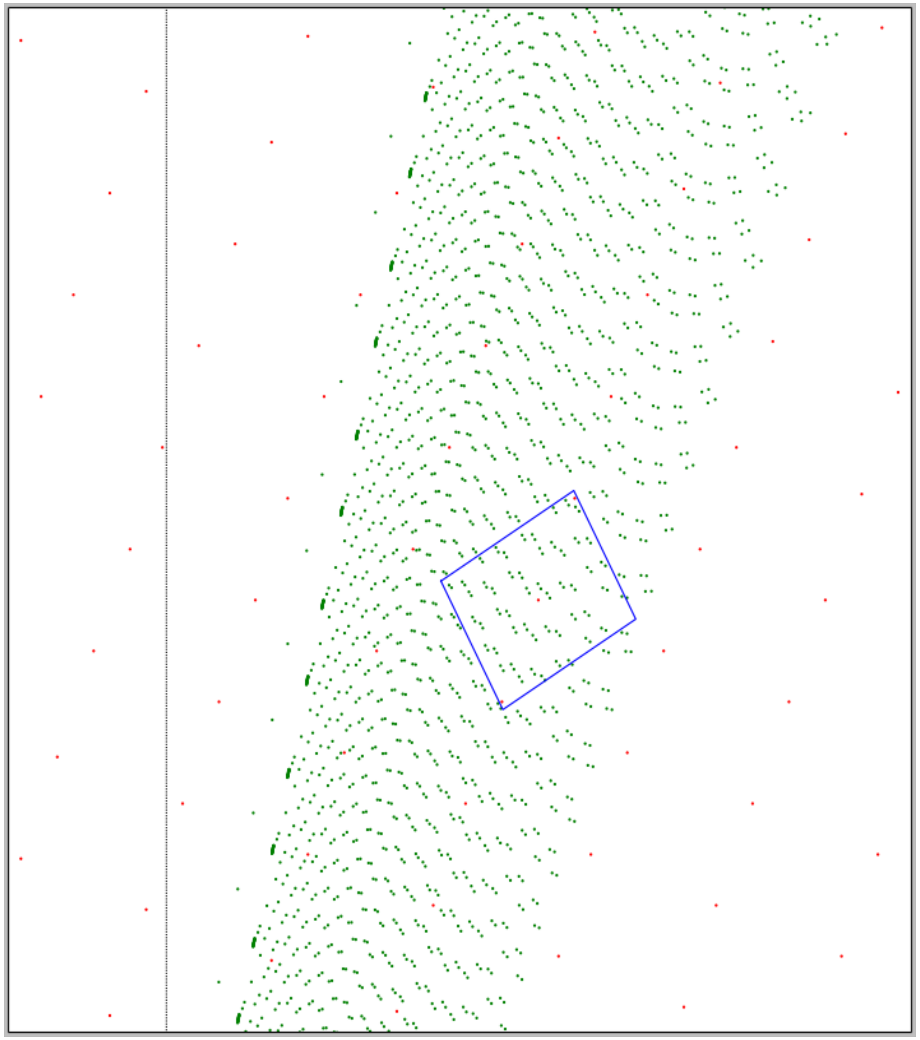
INTRODUCTION – CONTEXT





INTRODUCTION - DIFFICULTY





INTRODUCTION – ERROR BUDGET

ScaRaB-SW error budget @ 1σ ≈ 1,6%

Items	Value	Type	
Short wave calibration (sphere)	3% @2σ	Biais	1.5%
Error on spectral response		Biais	0.4%
Thermal gain correction	0.08%/° dT= 0.04° @1σ	Random	0.03%
Thermal leak correction	20% of the thermal leak@1σ	Random	0.04%
Location	0.06°@1σ	Random	0.4%
Budget at 1 sigma			1.6%

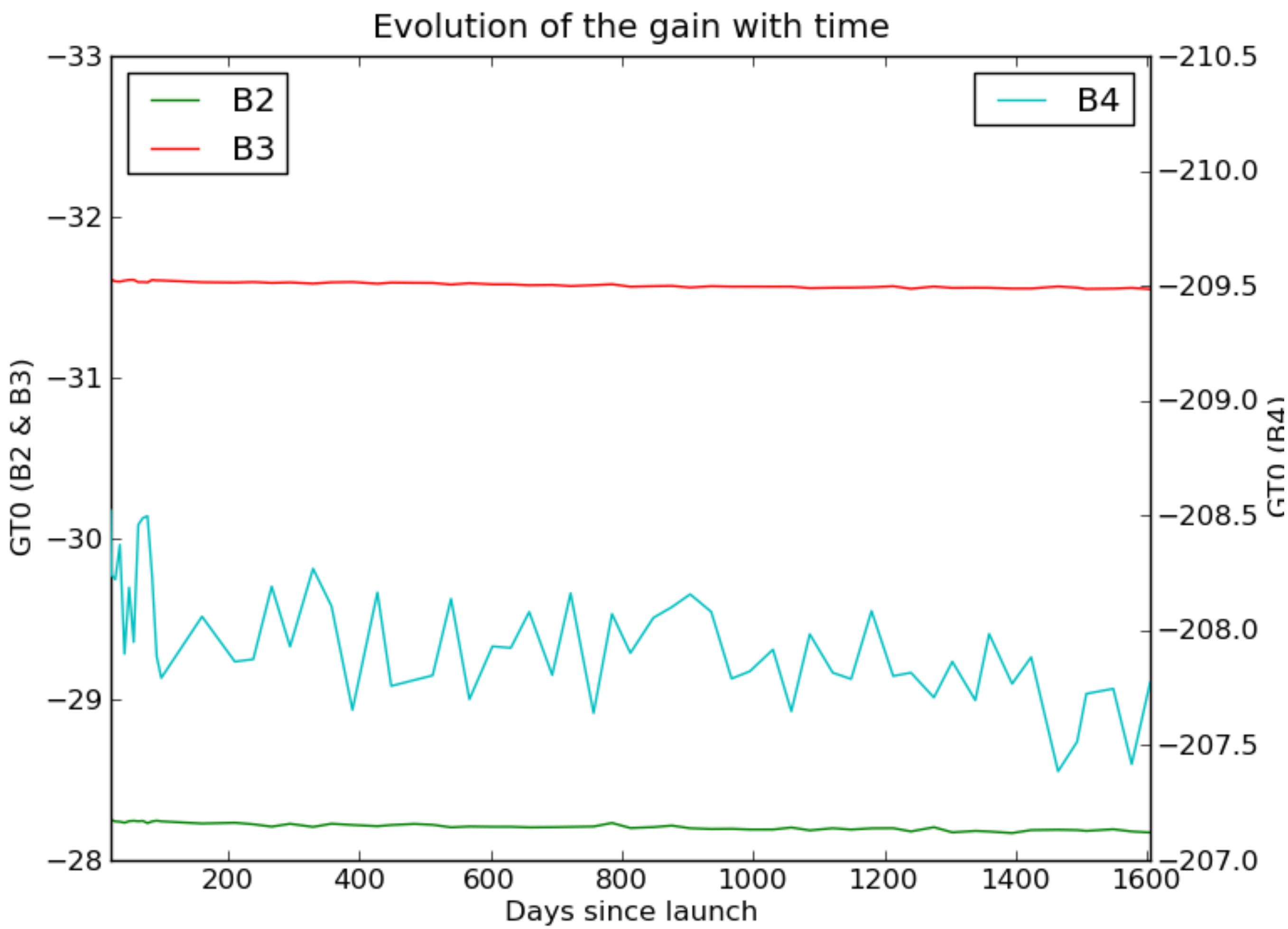
Rosak et al., 2012

CERES-FM2-SW error budget @ 1σ ≈ 1%

	Bias errors of unknown sign (W m^{-2})				
Source	Incoming solar	Outgoing SW	Outgoing LW	Net incoming	Comment
Total solar irradiance	±0.2	0	0	±0.2	Absolute calibration (95% confidence)
Filtered radiance	0	±2.0	±2.4 (N) ±5.0 (D)	±4.2	Absolute calibration (95% confidence)
Unfiltered radiance	0	±0.5	±0.25 (N) ±0.45 (D)	±1.0	- Instrument spectral response function - Unfiltering algorithm

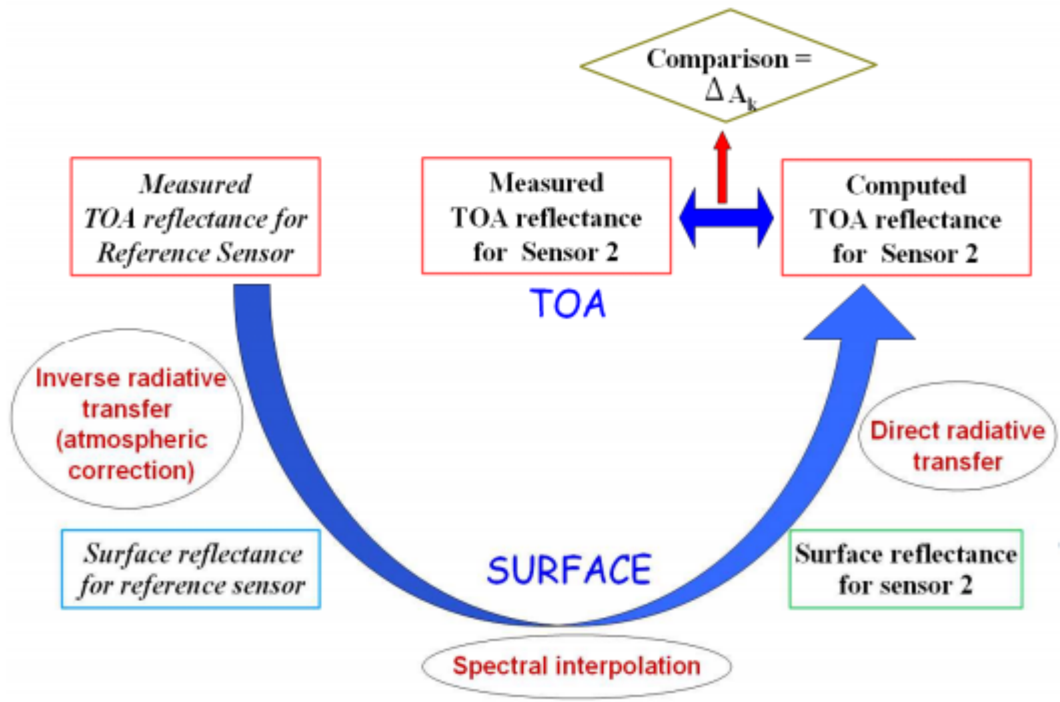
Loeb et al., 2009 [CERES-FM2 error budget @2σ]
They showed that their error budget was consistent with the climate monitoring.

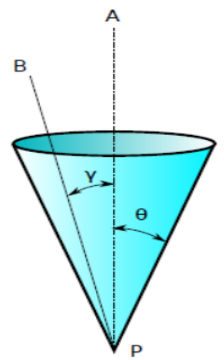
SCARAB INSTRUMENT STABILITY – RELATIVE GAINS



SCARAB INSTRUMENT STABILITY – MONITORING OF C1

Temporal monitoring of C1 using desert sites





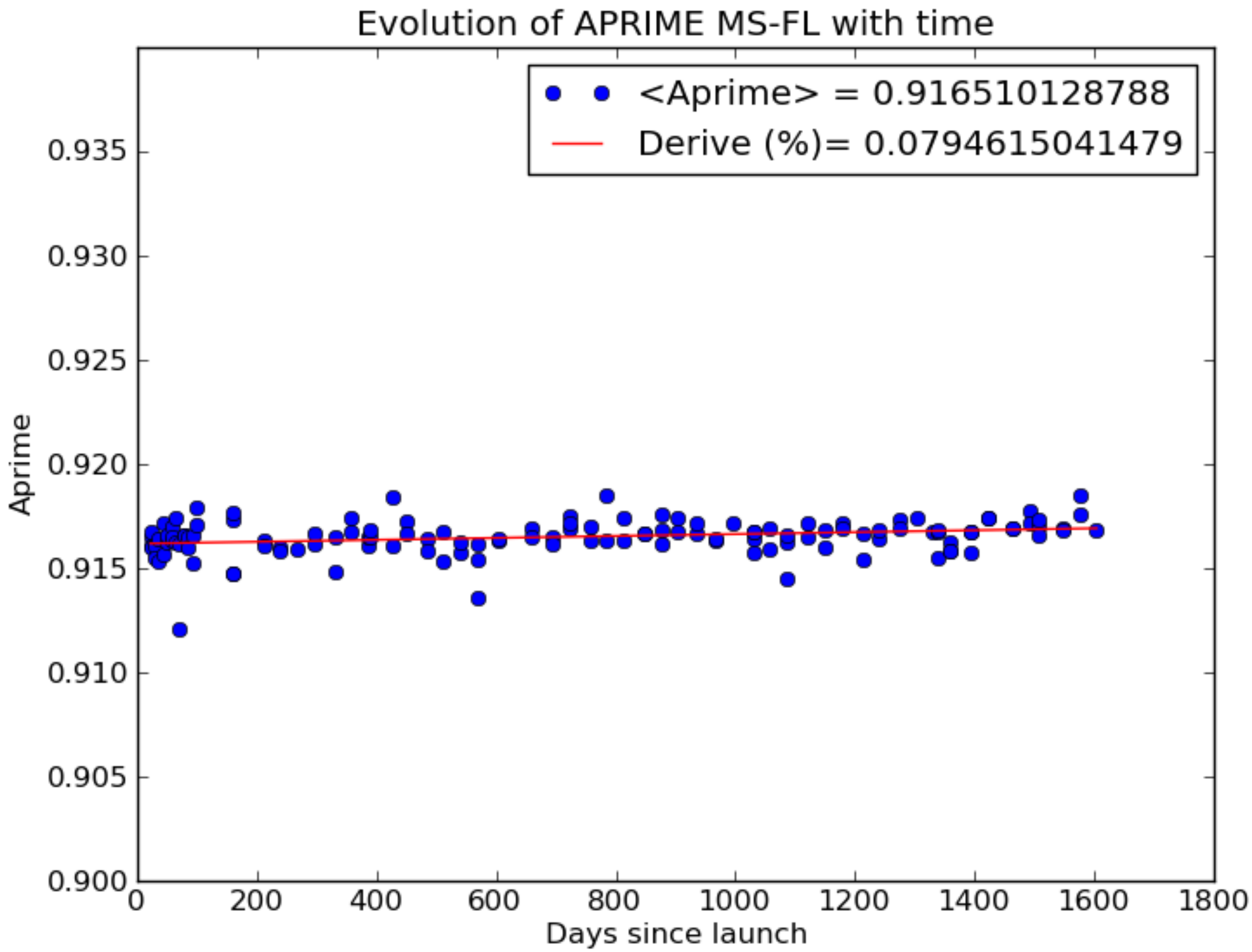
$\theta = 1, \gamma = 1$ et $d\varphi = 2$

$\theta = 2, \gamma = 2$ et $d\varphi = 5$

$\theta = 5, \gamma = 5$ et $d\varphi = 10$

Triplet		1-1-2	2-2-5	5-5-10
MERIS	*N*	119	1321	16724
	Ratio	0.9862	0.9870	0.9854
MODIS	*N*	246	2122	27016
	Ratio	1.0370	1.014	1.012

SCARAB INSTRUMENT STABILITY – APRIME COEFFICIENT



FIRST APPROACH: METHODOLOGY

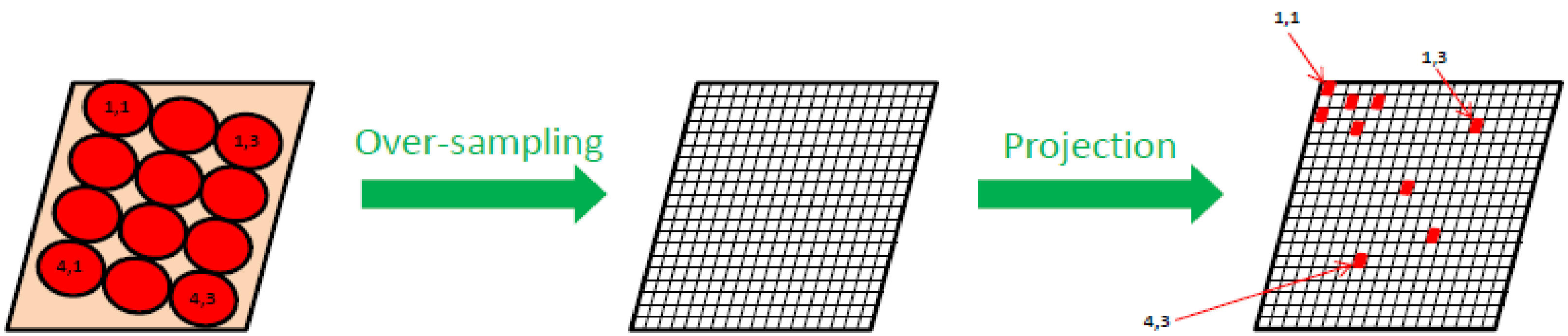
To project CERES pixels onto ScaRaB pixel, several steps are necessary :

1- We define the colocation area between the two instruments to reduce computing time.

2- ScaRaB footprint is about 40 km x 40 km at Nadir. We need to over-sample this pixel to project CERES pixel onto it.

3- We locate the nearest CERES pixel of the ScaRaB sub-pixel (over-sampled).

4- Each CERES pixel projected onto ScaRaB sub-pixel is defined by new coordinate. We use the latter to project CERES radiances.



ScaRaB + CERES pixels

ScaRaB pixel over-sampled by a factor k

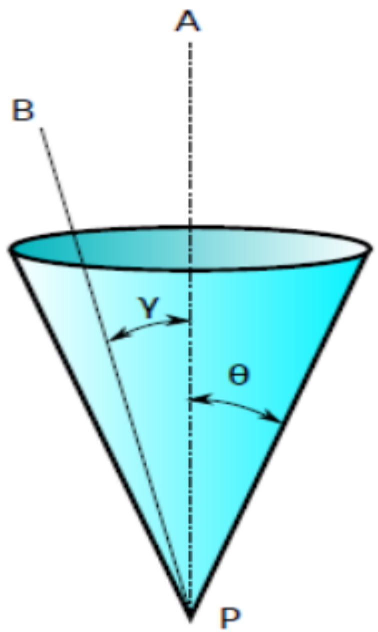
CERES pixels projected onto ScaRaB over-sampled grid (nearest neighbor)

FIRST APPROACH: SELECTION OF CERES PIXELS

To select a CERES pixel onto ScaRaB pixel we apply several criteria:

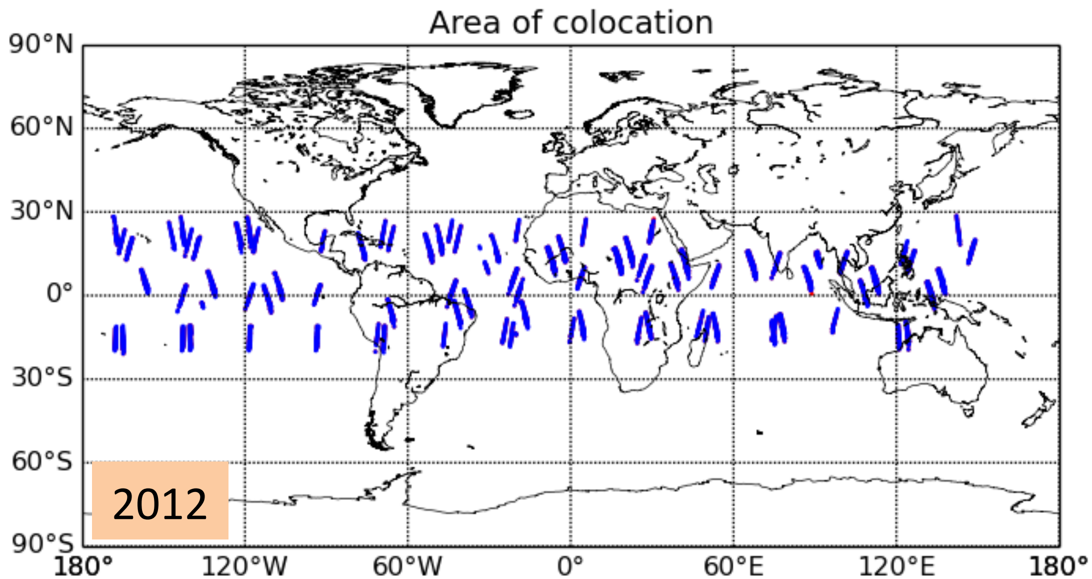
- Acquisition time difference lower than 5 minutes
- Conical aperture with an aperture of 5 degrees (solar & viewing angles)
- Occupation threshold (lowest number of CERES pixel onto ScaRaB sub-pixel)
- Heterogeneity threshold of CERES pixels (onto ScaRaB sub-pixel) lower than 10 %

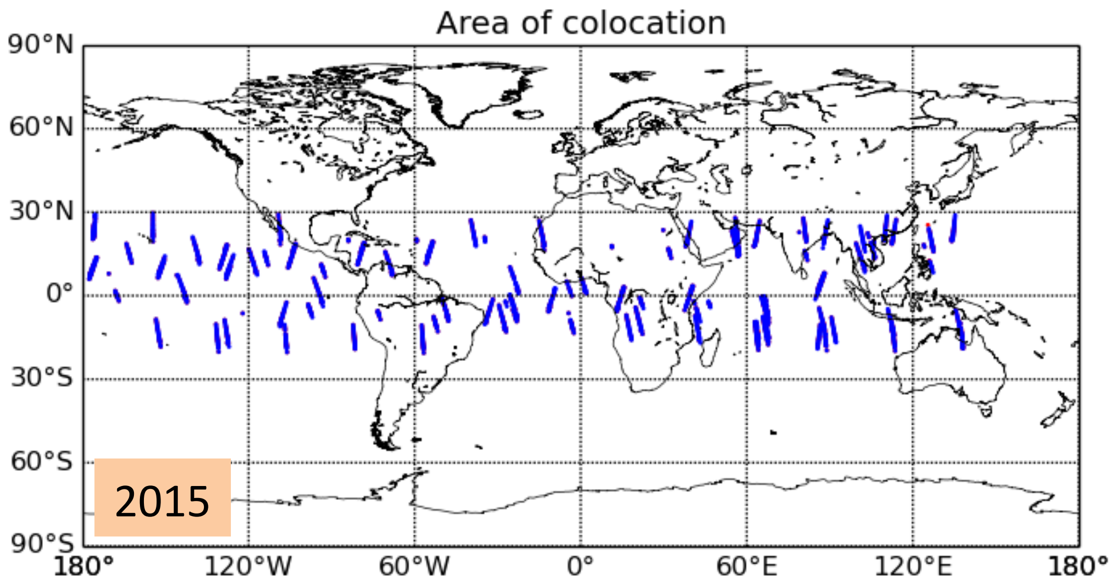
NB: For *k*=10, occupation threshold is set to 10



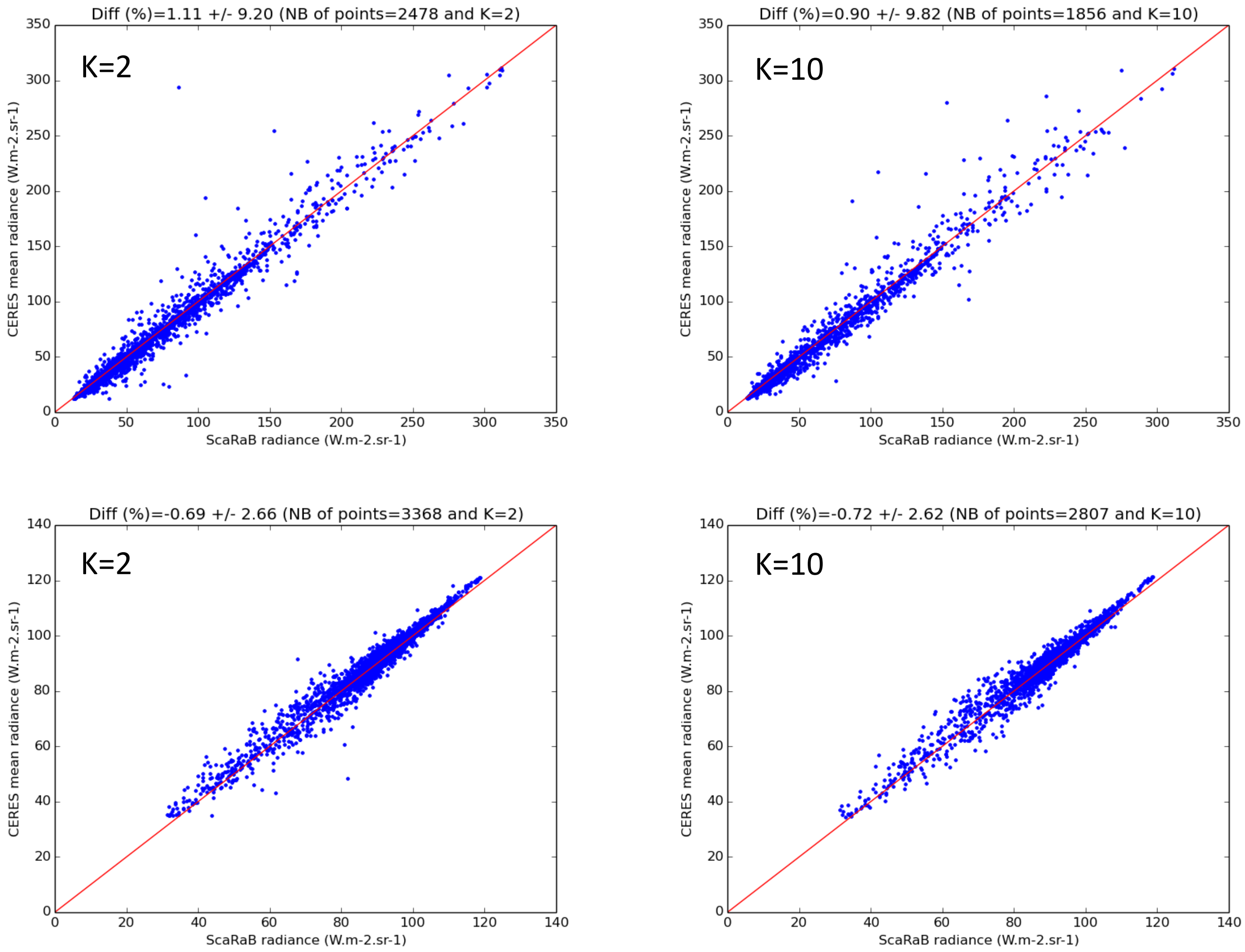
$$\boxed{\frac{ScaRaB - CERES}{mean(CERES)} \text{ (in \%)}}$$

FIRST APPROACH: RESULTS – COLOCATION AREA

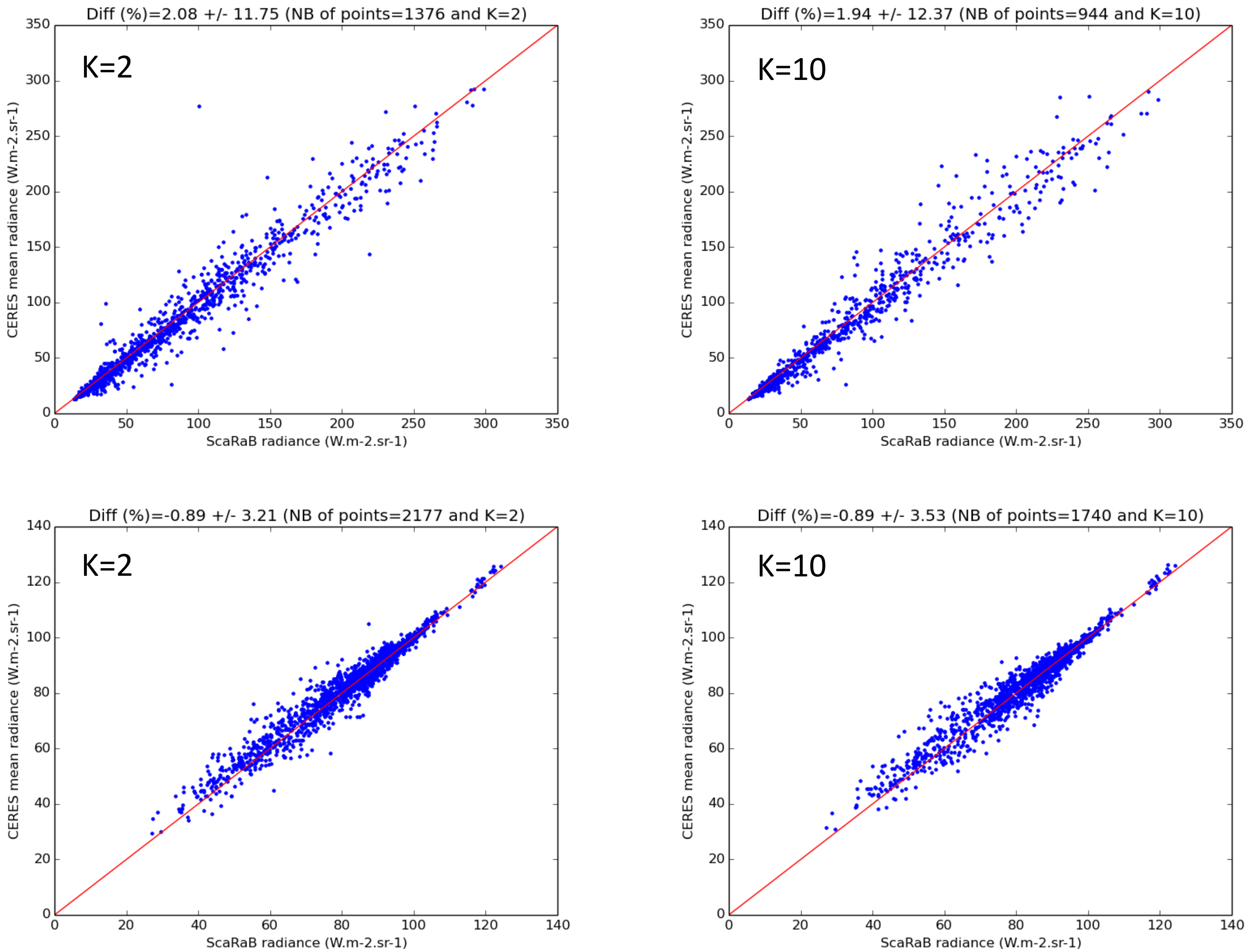




FIRST APPROACH: RESULTS – CAMPAIGN OF 2012

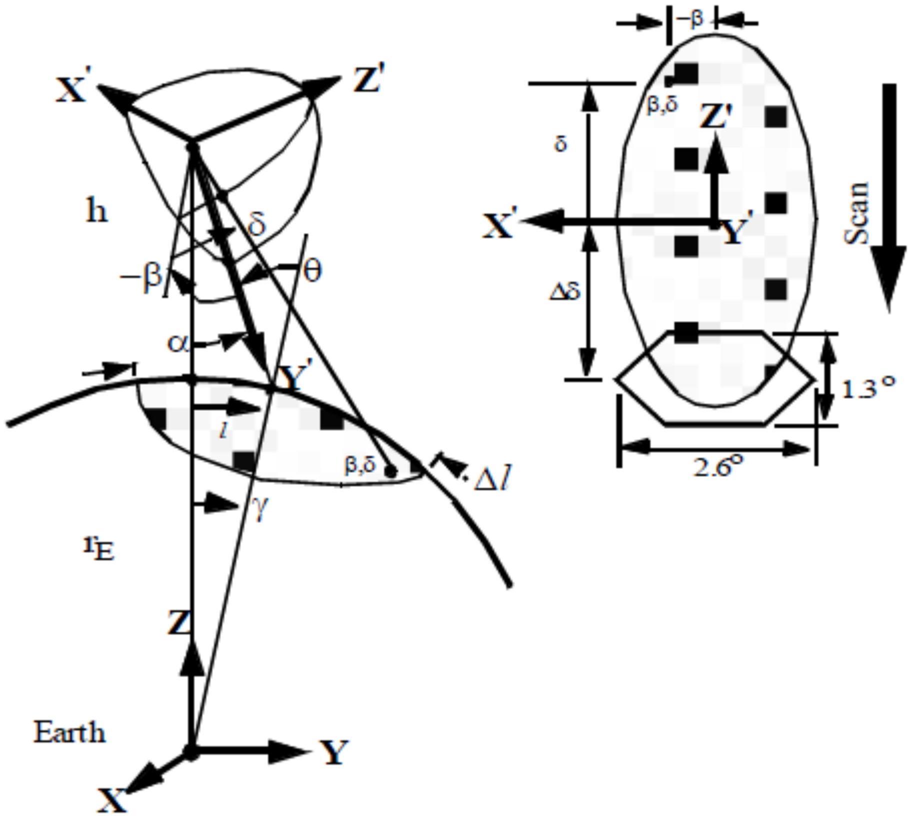


FIRST APPROACH: RESULTS – CAMPAIGN OF 2015



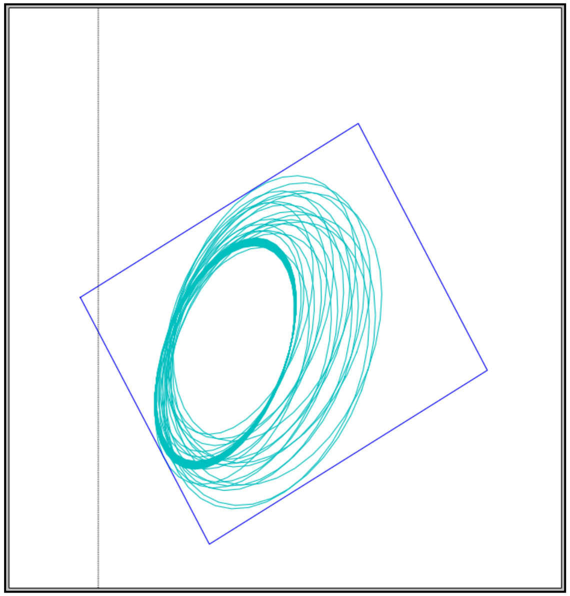
IMPROVEMENT OF THE COLOCATION METHOD

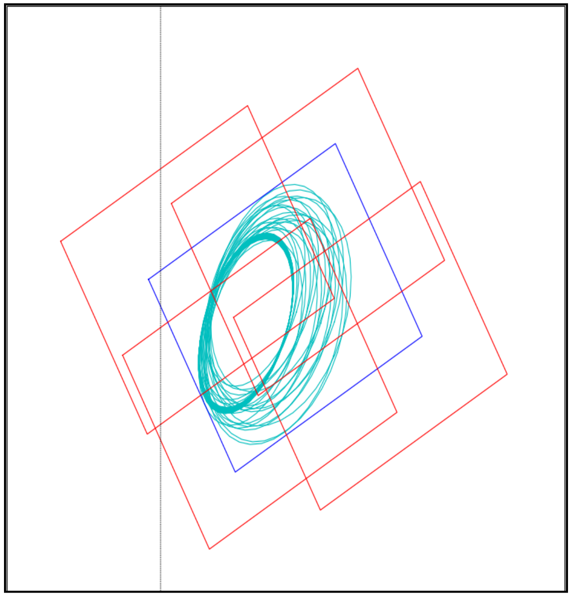
In our first colocation approach we considered a **circular** CERES *footprint* with a **20 km** diameter (at Nadir). It was a good approximation. In order to improve our results, we need to consider the real CERES *footprint*.



Scanner Footprint

IMPROVEMENT OF THE COLOCATION METHOD

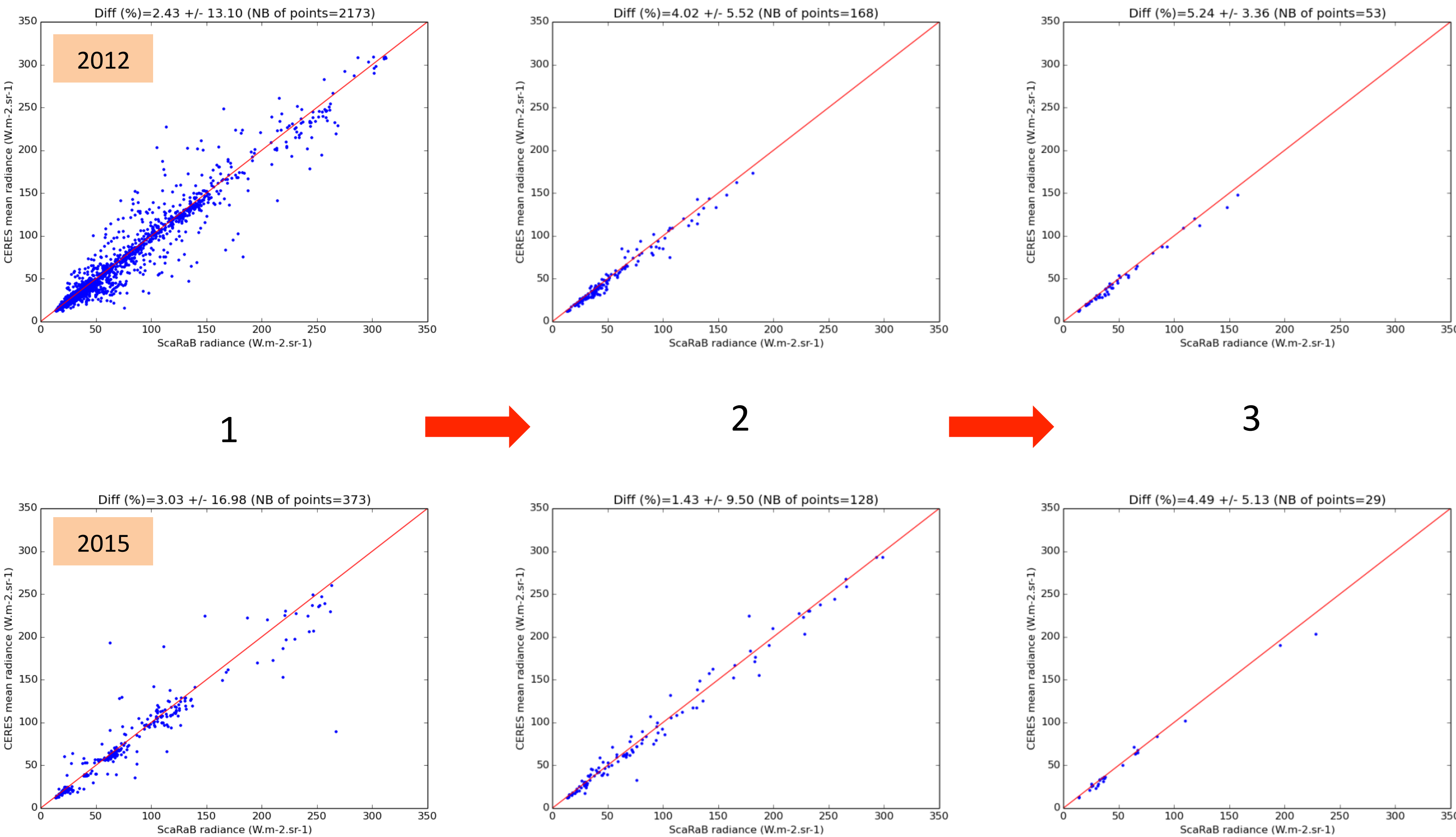




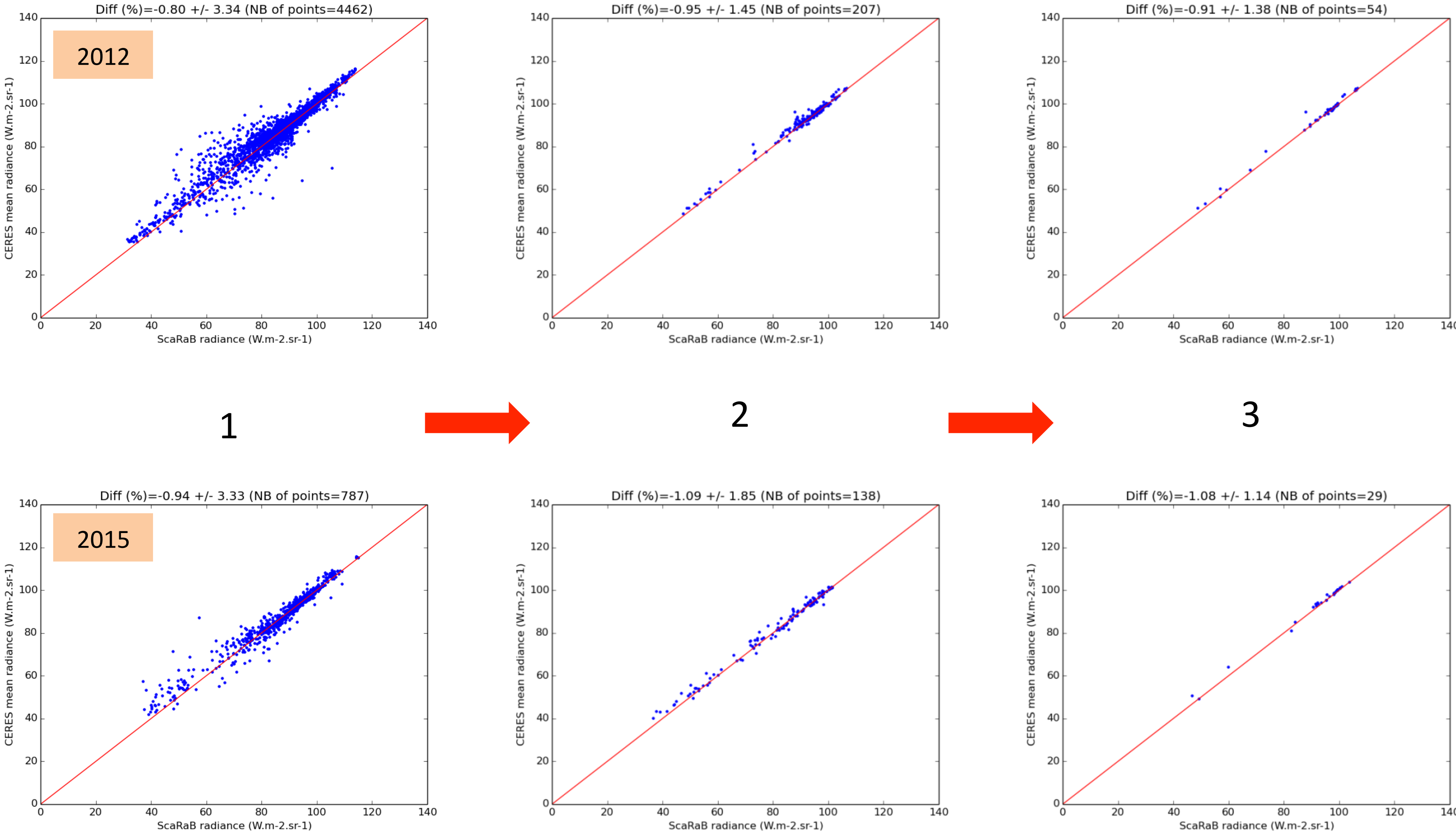
To improve our colocation method, we considered three kinds of improvements :

1. We consider the **real** CERES *footprint* (left caption).
2. The **entire** CERES footprint (cyan) must be contained in the ScaRaB footprint (left caption).
3. We **only** considered ScaRaB pixels which present radiometric homogeneity (right caption) – neighbors heterogeneity (red) is lower than 10 %.

SECOND APPROACH: RESULTS FOR SW



SECOND APPROACH: RESULTS FOR LW



SECOND APPROACH: IMPACTS

Impact of the colocation method on the relative difference between CERES and ScaRaB:

- For SW
  - In 2012: 0.9 % => 5.24 %
  - In 2015: 1.94 % => 4.49 %
- For LW
  - In 2012: -0.72 % => -0.91 %
  - In 2015: -0.89 % => -1.08 %

Impact of the colocation method on the dispersion of the relative difference between CERES and ScaRaB:

- For SW
  - In 2012: 9.2 % => 3.36 %
  - In 2015: 11.75 % => 5.13 %
- For LW
  - In 2012: 2.66 % => 1.38 %
  - In 2015: 3.23 % => 1.14 %

cnes

CONCLUSIONS

- Taking account of the real CERES *footprint* improves inter-sensor calibration results.
- Best results are obtained using homogeneous ScaRaB pixel containing the entire CERES footprint.
- For SW, we note a degradation of the results between 2012 and 2015.